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Translation

ORGANIZATION AND TECHNOLOGY OF RIVER-SHIP REPAIR

By

V.F. Fedorov

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ORGANIZATION AND TECHNOLOGY OF RIVER-SHIP REPAIR

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[Excerpts from the book "The Organization and Technology of Ship Repair," by V.F. Fedorov]

[Excerpts] Part One. The Organization of Ship Repair

Chapter 1. Supervision of the Technical Condition of Ships

§1. Organization of the Engineering Supervision over Ships on the Part of the Registry

Constant engineering supervision has been established over every ship in order to provide for its navigational safety and for its continuous and economical operation. This includes a systematic check of the hull, main and auxiliary machinery and the ship's devices and systems. Supervision over the technical status of ships is performed by the state organization for classification and engineering supervision called the Registry, and by the fleet owners--the shipping lines, the basin waterways administrations (BUP's) and the navigable-canal administrations (USK's).

The Registry was established in the USSR in 1923 and was named the Russian Registry. In 1925 it was renamed the USSR Registry. The USSR Registry (Maritime) now exercises engineering supervision over maritime ships and ships of mixed riverine-marine navigation.

The main task of the Registry is that of state engineering monitoring over ships that have been built and are being operated and that belong to state, cooperative and social organizations, institutions and enterprises.

The Registry establishes to what extent the design of ships and the quality of the work that they do meet the requirements for reliable operation, the safety of navigation and of the people on them, and the safekeeping of the cargo being hauled. Maritime ships built in accordance with the rules and under the superintendence of the USSR Registry are assigned a class designation for a certain period of time and are issued a classificational

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document (a certificate). A USSR Registry class designation is also awarded to transport ships of mixed riverine and marine navigation (11-SP) of the Ministry of the River Fleet. A ship that is being operated retains its class designation through the conduct of periodic routine, annual and graving-dock inspections and by execution of the repair work required in accordance with the results thereof.

In the RSFSR engineering supervision over ships of the internal waterways (ships owned by the state, cooperatives and social organizations, or by individual citizens, except for ships that sail under a military or naval flag and sports ships) is performed by the RSFSR River Registry, which separated from the USSR Registry in 1957 and also is a state organ of classification and engineering supervision. It is under the jurisdiction of the Ministry of the River Fleet (in other Union republics it is an administration under the republic councils of ministers) and is subordinated to the ministry. The line organs of the River Registry are the basin inspectorates, which are located in the areas of assignment of the shipping lines, the BUP's and ship-repair enterprises. The inspections are made by a staff of engineer-inspectors of various specialties. The inspectorates should be guided in their work by the Rules for Classification and Technical Supervision over River and Lake Ships, the implementation of which is mandatory for all organizations and enterprises that build and operate the indicated ships.

The main functions of the River Registry are to develop rules, norms and instructions for the construction of internal-waterways ships and rules for the classification and engineering supervision over the ships that are being operated, to review and coordinate designs for and to exercise technical supervision over ship construction, to classify ships as a function of their mission, to certify hulls, machinery, steam boilers, air tanks and electrical and radio equipment, and, with a view to assuring the safety of navigation, to establish the height of the freeboard and the passenger capacity of ships. The River Registry also exercises technical supervision over the restoration and reequipping of ships.

Each ship built in accordance with the requirements of River Registry rules and norms is awarded a River Registry class designation for a definite period and is issued a certificate. The formula for the class designation is written in the Book of Ship's Documents. The classes M-SP, M, R and L are awarded in accordance with the rules of the River Registry to ships that sail the inland waterways.

The class M-SP, for mixed riverine and marine navigation, is awarded to ships that go to sea no more than 50 nautical miles from a sheltered place; class M to ships that have the right to navigate in the estuaries of large rivers and to sail to marine coastal regions; class O to ships with the right to navigate on all large rivers and water-storage basins; class R to ships that have the right to navigate on all rivers and on small water-storage basins; and class L to ships built for navigation on the upper reaches of large rivers and on small rivers.

Retention of the River Registry class designation of an inland-waterways ship that is in operation is provided for by the River Registry's conduct of periodic inspections and by execution of the repair work required in accordance with the results thereof.

The River Registry conducts initial, routine, special and extraordinary inspections of ships.

The initial inspection is done upon completion of a ship's construction, prior to its introduction into operation. It is done in order to reveal design peculiarities of the hull and the ship's devices, and machinery and boiler installations, to determine the reliability of their operation, and to establish the height of the freeboard, the load-carrying capacity and the ship's navigational region. The ship is awarded a River Registry class designation according to the results of this inspection, and a document is issued that allows it to sail.

Routine inspections of ships with metal and reinforced-concrete hull and of the machinery installations of steel ships is performed, as a rule, every 3-5 years. It is performed with a view to revealing the ship's technical condition. Usually this inspection coincides with intermediate repair or overhaul of the ship. The inspection is performed prior to the repair and after completion thereof.

Special inspection is performed in order to determine the technical condition of a ship in an intervening period, between routine inspections. In this case the technical status, reliability and safety in operation of the ship's hull and the ship's machinery, devices and electrical equipment are determined. Such an inspection is made at any time during the navigation season, but insofar as possible it is confined to occasions when the ship is presented for sailing or for inspection by an inspection center. Passenger-and-cargo ships, oil tankers and ships of the M and O classes are subjected to a special inspection each navigation season, other ships at least once every other navigation season.

An extraordinary inspection is performed after an accident or an emergency occurrence (damage to the ship's hull or its mechanisms) in order to pinpoint the cause of the damage and to determine the amount and nature of further work to bring the ship to working condition, or to formalize writeoff thereof.

The decision of a River Registry inspector adopted after a ship has been inspected can be reversed only by the chief of the inspection center or by the Director of the River Registry.

The River Registry inspector records in detail data about the technical status of the ship's elements (hull, mechanisms, boilers, electrical equipment and so on) in accordance with the rules of each inspection and indicates the observed defects in the Book of Ships' Documents of the River Registry on the ship's worthiness for navigation. Depending upon the degree of reliability of the ship's elements, he issues the document for the right to navigate.

River Registry rules have established four evaluations of the technical condition of river and lake ships: "good," "satisfactory," "limited suitability" and "prohibited." An evaluation of technical status is conferred on ships in accordance with the evaluations of the technical status of their main elements, taking the soundness and reliability of operation of these elements into consideration.

According to River Registry rules, the main elements of a ship include: the hull--the outside plating, the framing, the main deck, the watertight bulkheads, the inner bottom plating and the superstructure, which are factors in the overall soundness of the hull; the machinery--the main engines, the shaft lines, hydraulic, geared and other transmissions off the main engine onto the propeller shaft, auxiliary mechanisms that serve the main engines, and the cooler installations of refrigerator ships; boilers--the main boilers (fire-tube and water-tube) and the fixtures, pipelines and feed equipment; the electrical equipment--the main electric motors and cable network of an electrical propulsion installation, the generators of the ship's electric-power plant and power transformers, electric-propulsion control panels, the main switchboard panels, the electric drives of the main pumps, and the feed cables of the drives.

An evaluation of "good" technical condition is awarded to a ship if all its main elements are evaluated as "good," a "satisfactory" evaluation if one of the main elements is rated "satisfactory," an evaluation of "limited suitability" if one of its main elements is evaluated as of "limited suitability," and an evaluation of "prohibited" if one of its main elements has been evaluated as "prohibited," that is, its deterioration exceeds the norms established for a ship with an evaluation of "limited suitability," which indicates that the ship is in a condition dangerous for navigation.

Chapter 2. The Classification of Ship Repair.

§5. The Purpose of Ship Repair and the Concept of Deterioration

Ship repair is a system of measures of an organizational, technical and industrial nature that are methodically conducted and correlated with each other and that are aimed at eliminating defects, at preserving the high technical status of the fleet and the operational and technical characteristics set forth in the descriptive documents of ships, and at preventing the deterioriation of and damage to ships.

During operations, the structures, machine parts and mechanisms of a ship lose their original qualities and constructional dimensions, as a consequence of which they are subjected to various types of deterioration or damage.

The reduction in the original geometrical sizes and the change in shape and, sometimes, even of the structure of the metal of engine or mechanism parts and of individual elements of a ship while it is operating, is called deterioration. The gradual change of the initial dimensions and

of the properties of the structures of the components and parts is called wear. It is marked by loss of weight, volume, strength and so on.

The amount of deterioration of parts per unit of time is called the rate of wear. It can be determined in accordance with the formula

$$u = И/t, \qquad (1)$$

where u is the deterioration per unit of time, in microns/hr $[\frac{1 \cdot 10^{-6}\ m}{3{,}600\ s}]$;
И is the deterioration of the part, in microns; and
t is the length of time the part has operated, in hours.

A distinction is made between physical deterioration and deterioration in technical and economic competitiveness.

Physical deterioration occurs as a result of physical or chemical processes and is reflected in the gradual depletion of a ship's technical and operational qualities. It is normal or accelerated. Normal physical deterioration of a ship occurs as a result of the constant or periodic effect on it of such factors as: friction, corrosion, erosion, elastic and plastic deformation, and so on. It is practically impossible to eliminate completely the effect of these factors, but speed of wear can be reduced by design, manufacturing, operational and other measures. Accelerated physical deterioration results from the violation of the Rules of Technical Operation, low quality of assembly or mechanisms, delay in cleaning the hull and mechanisms of operational deposits, design deficiencies and so on.

Physical deterioration is of a completely defined nature, and its amount can be understood and theoretically substantiated. Knowing the rate of wear, the service lives of mechanism parts and components prior to maximum deterioration can be determined, and the amount of repair and the deadlines for repairing these parts can be established. That deterioration of individual ship elements at which their operational and technical characteristics are sharply degraded is called maximum deterioration.

If the sizes of worn parts do not assure minimal permissible reserves of strength (reject sizes), then such parts should be replaced or restored.

Three types of physical deterioration of the ship's hull structure are differentiated: corrosional-erosional deterioration--the gradual destruction and thinning of the metal as a result of chemical or electrochemical processes and the effects of the impacts of solid or liquid particles; deformation of the plating and framing--damage to the hull structure as a result of collision thereof with foreign bodies during operation or of incorrect technology in the construction or repair of the ship; and the destruction of the hull structure or the damage of individual elements thereof (that violate the integrity of the metal) as a result of accidents or of inadequate strength.

The main type of physical deterioration of a ship's hull structure is corrosional-erosional deterioration of the metal. Corrosion is divided, in accordance with its physico-chemical nature, into chemical and electrochemical corrosion. Chemical corrosion occurs as a result of the chemical interaction of the metal with the environment; it is observed in the effect of dry gases and liquid nonelectrolytes on the metal. This corrosion is especially harmful to the hulls of oil tankers, which are affected by sulfur compounds that are dissolved in the petroleum products, and the metal in the compartments and tanks disintegrates very much. Hydrogen sulfide, which separates from the oil and accumulates in the upper portion of a compartment, acts on the metal and destroys the inner surface of the deck covering and the sides and bulkheads of the ship. Electrochemical corrosion is the process of destruction of a metal when it comes in contact with liquids that conduct an electric current (electrolytes). This type of corrosion arises where scale, which is a good conductor of an electrical current and is a powerful cathode, appears on a steel surface.

Corrosion is divided into uniform (general) corrosion and nonuniform (local) corrosion, according to the nature of the destruction. With uniform (general) corrosion, relatively uniform destruction of the metal over the whole surface occurs; with nonuniform (local) corrosion, separate portions of it are affected.

The hulls of ships of combined riverine and marine navigation are especially subject to corrosion damage.

The parts vulnerable to the greatest damage are the outer plating of the part of the hull that is above the water, essentially at the waterline level and above, the stern part in the area of screw operation, welded joints, hull framing in places that are difficult to inspect and clean, steel deck planking, and hatch coamings and other coamings that alternately come in contact with air and water.

The process of damage to metal caused by flows of water saturated with air is called erosion. Most vulnerable to it are the hull plating in the stern part of the ship's screws, the sternpost, the screws, the shrouding and the propeller shaft struts.

Ship mechanisms become worn mainly as a result of the friction of moving parts. The degree of wear depends in this case upon the design, the quality of the material of the rubbing pairs, the correctness of assembly and the lubrication system. The wear characteristics of the rubbing surfaces of mating parts are shown in figure 1. Depending upon how long the part has been operating, the deterioration of the surface is divided into three periods: break-in, normal operation, and intensified wear.

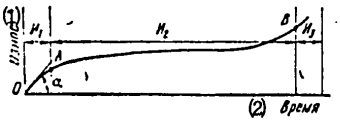
During the first period, intensive wear of the rubbing surfaces of parts occurs as a result of manufacturing roughnesses that remain on them after mechanical machining and that cause substantial specific pressures and the violation of lubrication specifications. As the surface becomes broken in, the speed of wear is reduced. The second period (AB) is longer

and is marked by the normal deterioration of a surface after it has been broken in. The speed of surface wear in this case is fairly constant. The third period is marked by an increase in the rate of wear as a result of dynamic loads because of an increase in the clearances and other factors.

Figure 1. Characteristics of the Deterioration of the Rubbing Surfaces of Mated Parts.

$И_1$. Break-in.
$И_2$. Normal operation.
$И_3$. Intensified wear.

1. Wear.
2. Time.



The physical deterioration of a ship depends not only on its design and constructional qualities but also to a great extent on the quality of servicing and the maintenance of the hull structure in proper operating condition, and on the timeliness and quality of execution of repair and overhaul work.

That condition under which a ship and its machines and mechanisms, while preserving full operating efficiency, do not meet the requirements of economic expediency and profitability in operation in comparison with new ships, machines and mechanisms of the same type, is called obsolescence. It can be reflected in two ways: a reduction in the cost of building ships, machines and mechanisms because of an increase in labor productivity (obsolescence of the first type) and in the technical obsolescence of ships, machines and mechanisms because of the creation of new, more productive ships, machines and mechanisms having the same purpose (obsolescence of the second type). Obsolescence necessitates the replacement of aging ships with new ones--ones that are more modern, economical and productive--or the modernization of them during repair.

Change in the original geometric shapes of parts of the hull and of parts of mechanisms as a result of unsatisfactory operation of the ships or of design deficiencies, as well as of violations of the technology for repairing them, is called damage.

§6. Classification and the Periodicity of Ship Repair.

In order to maintain ships in good technical condition, it is necessary periodically to repair their hulls, mechanisms, systems and equipment.

Various systems for ship repair are known: "as needed," preventive, and planned-preventive repair.

In the USSR, the planned-preventive system of repair (PPR) has been adopted for the repair of equipment, structures and transport means--the most progressive way of organizing repair work. Under this system, a ship,

regardless of its technical condition, is subjected on previously set dates (under a planned procedure) to repair and preventive servicing to an extent that will assure its full operating efficiency. During the repair, work that will prevent the progressive wear of mating surfaces and will aid further operation of the ship until the next repair is performed.

The planned-preventive repair system determines the type of repair, the periodicity of its execution according to a previously prepared plan and schedule, the duration of the repair cycle, and the periods between repairs for the various categories of repair, depending upon the type and mission of the ship and on operating conditions.

The calendar time interval during which all the repair operations (or the repair) are carried out is called the repair cycle. The period of ship operation time between two consecutive planned repairs is called the interrepair period.

The length of time between interrepair periods is measured by the number of navigation seasons (years) that the ship has been operated. The number of hours worked has been adopted as the measurer of operation of main ship engines and of individual types of ship equipment.

PPR periods, as a rule, are coordinated with the dates for inspections and certification by River Registry organs and with the fleet owners.

The planned-preventive system of repair requires systematic study of the technical-operational qualities of ships and mechanisms, the establishment of standards for permissible deterioration of various sections, components and parts. This system of organizing repair enables not only the technical condition of the fleet to be preserved and raised, but also the workload and development of ship-repair enterprises to be correctly planned and the parts necessary for the repair of the ships to be procured.

The amount of repair and the periods between PPR's are set on the basis of scientifically substantiated norms for deterioration of the hull and of components and parts of the mechanisms of ships: systematic observation of the condition of ships, which is performed during operation and repair by the ship's crew, by the shipping line (or BUP or USK), and monitoring organizations--the River Registry, Gossaninspektsiya [State Sanitary Inspectorate], the Militarized Fire and Patrol Guard (VOKhR), the navigability inspectorate, and the technical inspectorate of the Trade Union of Workers of the Maritime and River Fleets; and the conclusions of the technical commission (decisions on establishment of the amount of repair for each ship).

All river-fleet ships, except for various ships of obsolete design not produced in series, the execution of whose shipyard repair is not desirable for economical or technical reasons, are repaired under the PPR system.

The PPR system includes three categories (or types) of repair: current repair, intermediate repair and overhaul. During intermediate repair and overhaul, and, for various types of ships, during current repair, the ship has to be placed on a slipway or in a graving dock periodically--preventive inspection and repair of the underwater portion of the ship's hull is performed by lifting the ship onto a slipway or putting it in a graving dock or by baring the underwater portion of the hull by any other method.

Current repair is that type of repair, minimum in volume, that will assure maintenance of the ship in normal technical condition for one navigation season following the repair. In so doing, inspection work, the partial disassembly of various mechanisms, and the repair or replacement of rapidly wearing parts of mechanisms and equipment are performed, as well as work on inspection and minor repair of the hull, with the replacement of metal (sheet and section) in an amount less than 3 percent of the total weight of the metal structure of the ship and its devices, systems and superstructure, and adjustment work.

Current repair is done in the period between navigation seasons (in the winter) and should be completed by the opening of the navigation season. The main repair operations in this case are done by the ship's crew.

Ship-repair enterprises do only that work that requires shipyard equipment, and they fabricate replacement components and parts.

Ships on which advanced methods of technical operation are used that provide for high technical sophistication of servicing for ships' parts and mechanisms during the navigation season spend the winter without current repair. Upon conclusion of the navigation season, the crews of such ships do only those preventive inspections and that minor repair work on such ships as will prepare them for winter layover (the fall preventive maintenance).

Current repair is done annually or once every 2 years. The two-year period is established for ships after a special set of measures that are worked out by the owners has been carried out.

Intermediate repair is the basic type of PPR. It is carried out for the restoration to ships of the class designation conferred by the Registry (by the USSR Registry for ships of combined riverine and marine navigation, by the River Registry for inland-waterways ships). Intermediate repair should assure operating efficiency of the ship and retention (or improvement) of its operating and technical qualities until the next intermediate repair or overhaul is performed, provided that in the intervening years the fall and spring technical servicing and current repairs are completed. Depending upon the type of ship, intermediate repair is performed once every 4 to 6 years. During intermediate repair, all ship elements are disassembled and their technical condition checked, worn parts of the hull, mechanisms, components and parts and devices are

restored or replaced, the metal replaced to amount to less than 8 percent of the total weight of the ship's metal structure.

During intermediate repair, the cylinder sleeves, piston rings, piston pins, connecting-rod bearings, valves and individual cylinder covers are bored, the fit zones of the cylinder blocks are machined, crankshaft journals are machined and polished, main-bearing hollows are calibrated, and the axes of cylinders and crankshafts are centered. Moreover, various modernization operations are called for during intermediate repair of a ship.

The date for accomplishment of intermediate repair can be postponed if the ship is in good engineering condition. The chief of the shipping line (or the BUP or USK) establishes the possibility of such a postponement upon submission of a technical commission report, which is coordinated with the River Registry. The date for accomplishment of intermediate repair can be postponed, but by no more than two navigation seasons.

Intermediate repair is performed by ship-repair enterprises during the winter, between navigation seasons, the operations to be completed and the ship turned over for operation by the opening of the navigation season. Prior to placing ships in intermediate repair, they are put on a slipway or in a graving dock.

Overhaul consists in the conduct of a set of operations that will assure the operating efficiency of the ship until the end of its service life, provided that current and intermediate repairs are carried out in the intervening years in accordance with the dates specified for the PPR system. The purpose of this type of repair is the restoration of all worn parts, mechanisms and equipment, the restoration of the strength of the ship's hull, the repair of the hull and of the metal superstructure, the metal replaced to be less than 20 percent of the total weight of the metal structure, and the elimination of defects of appropriate parts, mechanisms and equipment. Overhaul is performed by the personnel and resources of ship-repair enterprises, the ship being placed on a slipway, or a covered slipway, raised up on cribbing. As a rule, overhaul is accompanied by comprehensive modernization that will assure improvement of the ship's operational and technical characteristics, bringing them close to the level of ships being built at that time.

In accordance with their service lives and existing depreciation schedules, ships are overhauled after 12, 16, 17, 19, 20, 24, 25 and 36 years of operation (beginning with the day of construction), depending upon their type and purpose. Ships with a depreciation period of 30 years or more are subjected to overhaul. The cost of this overhaul should not exceed 40 percent of the ship's construction cost. The date for overhaul that is set by ship-repair rules can be postponed, in accordance with the ship's actual technical condition; this should be decided by an engineering commission appointed by the chief engineer of the shipping line (or the deputy chief of the BUP or USK) with the participation of a representative

of the SSKh [shipbuilding and ship-repair activity] of the shipping line (or the MSS [ship's engineering department] of the BUP), and the River Registry inspectorate.

The length of time between repairs under PPR is established by the rules for ship repair (table 1), depending upon the types of ship and their design.

The placement of ships on slipways or in graving docks is done to provide for the safety of navigation.

While ships are on slipways or in graving docks, preventive inspections are performed, the underwater portion of the hull is repaired, and the hull is cleaned and painted, with a view to protecting it against progressive deterioration.

As a rule, ships being operated on inland waterways are placed on slipways prior to intermediate repair or overhaul in accordance with a schedule worked out by the SSKh jointly with the shipping line's operations and hauling service (or the MSS and the waterways service of the BUP and the USK) and approved by the chief of the shipping line (or the BUP or USK). The schedule for placing the ship on the slipway or in the graving dock is a component part of the ship-repair plan.

If the ship's hull is not leaky and there are no breaks in the framing, or separations of the framing from the plating, the planned placement of the ship on the slipway can, with the coordination of the River Registry inspectorate, be postponed for a period not exceeding 2 years.

Ships that are used in the spring or fall for icebreaking are subjected to placement on a slipway each year.

Unplanned placement of a ship on a slipway (or in a graving dock) ordinarily is done when there is accidental damage to the hull's underwater portion.

The planned placement on slipways of inland-waterways ships of the M and O classes that are operated in coastal marine regions is carried out: during intermediate repair and overhaul where the ship operates in marine regions less than 50 days; not less than once in 3 years where the ship operates in marine regions an average of 50-90 days during the navigation season; and once each 2 years where the ship operates in marine regions for an average of more than 90 days during the navigation season.

Modernization and reequipping (or rebuilding) of ships is called for by shipping lines (or BUP's) in the plans for shipyard repair (for overhaul and intermediate repair).

The purpose of modernization work is to alleviate the obsolescence of various mechanisms or constructional components, to improve the ship's technical and economic indicators and operating qualities in accordance with

Table 1

Index of type of fleet	Types of fleets	Group index	Ship group	Years repairs are due (after date of construction)		Service life
				Intermediate repair	Overhaul	
I	Dry-cargo motorships	01	2,000 tons of cargo capacity	7, 13, 25, 30, 34	19	38
		02	700-2,000 tons of cargo capacity	7, 13, 25, 30, 34	18	38
		03	200-700 tons of cargo capacity	6, 12, 17, 22	--	26
		04	200 tons of cargo capacity	6, 11, 16	--	20
II	Tanker motorships	05	700 tons of cargo capacity	6, 11, 16, 24, 28, 32	20	36
		06	200-700 tons of cargo capacity	6, 11, 16, 20	--	24
III	Passenger-and-cargo and passenger motorships and diesel-electric ships	08	More than 600 hp	7, 13, 19, 30, 35	24	40
		09	300-600 hp, inclusive	6, 11, 21, 26	16	30
		10	Up to and including 300 hp	5, 9, 13, 17	--	20
IV	Hydrofoils, surface-effects ships and hydroplanes	11	With high-speed diesels	3, 6, 9, 12, 15	--	18
VI	Tugs and auxiliary-service motorships and diesel-electric ships	13	With engines of up to 500 rpm, inclusive	6, 11, 21, 26	16	30
		14	With engines of more than 500, to 1,000 rpm	6, 10, 15, 19	--	24
		15	With engines of 1,000 or more rpm	4, 8, 12	--	16
VII	Steam tugs	16	Of various power ratings	6, 11, 16	--	20
VIII	Dry-cargo barges	17	More than 1,000 tons of cargo capacity	8, 15, 25	20	30

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Table 1 (continued)

Index of type of fleet	Types of fleets	Group index	Ship group	Years repairs are due (after date of construction): Intermediate repair	Years repairs are due (after date of construction): Overhaul	Service life
VIII (continued)	Dry-cargo barges (continued)	18	Cargo capacity of more than 300 tons to 1,000 tons, inclusive	6, 11, 16, 21	--	25
IX	Tank barges	20	More than 200 tons of load capacity	6, 11, 21, 26	16	30
XI	Oilers and repair ships	24	Metal	8, 15, 25, 30	20	35
		25	Reinforced concrete	8, 15, 21, 26, 31, 43, 48, 52, 56	36	60
XII	Suction and other dredges	26	More than 400 m^3/hr productivity	5, 9, 13, 22, 26	17	30
		27	Productivity of up to 400 m^3/hr, inclusive	5, 9, 13, 17, 21	--	25
XIII	Dump scows	28	Self-propelled	4, 8, 16, 20	12	24
		29	Nonself-propelled	4, 8, 12, 16	--	20
XVI	Riverine-marine motorships	36	Dry-cargo ships	6, 12, 20, 24, 28	16	32
		37	Tanker	6, 11, 20, 24, 28	16	32
		38	Tugs	7, 12, 22, 26	17	30

modern development of equipment, and to integrate mechanization and automation of the processes of servicing them, which will provide for a rise in labor productivity or of sophistication of hauling, as well as an improvement in the working and living conditions of the ship's crew.

Ships are reequipped or rebuilt when there is a change in operating conditions or mission, region of navigation, type of power plant, and so on.

The desirability of modernizing or reequipping (or rebuilding) a ship should be established by a technical and economic analysis. This work is performed under long-term and annual plans for modernizing the fleet, which are components of the ship-repair plan.

Modernizing operations are, as a rule, confined to intermediate repair or overhaul. In this case, the work is done according to standard technical documentation during the repair cycle, without extending it.

Serially produced ships are modernized under a design that has been revised in accordance with the results of tests of a test ship of the given series under operating conditions.

Some modernization measures and operations associated with improving working and living conditions for the ship's crew can be performed during current repair.

Modernization and reequipping of ships includes:

reequipping ships for change in the category of navigation or for the hauling of special cargos, and equipping them with loading installations, with equipment for mechanization within the ship's holds, with electronic or radio navigation devices, and with installations for processing drinking and sanitary-engineering water;

increasing the power of the main engines;

replacing obsolescent power-supply installations with modern ones, equipping the ship with remote-control and automatic devices for control of the main and auxiliary mechanisms, and changing components and parts of the hull structure, and devices, systems, mechanisms and equipment that will raise wear resistance, extend service life and reduce costs; and

raising the haulage and speed of the ship, and mechanizing labor and the system for servicing the ship's mechanisms, and other actions.

§7. Categories (or Types) of Repair That the Planned-Preventive Repair System Does Not Include

In addition to the basic categories (or types) of ship repair (current repair, intermediate repair and overhaul), there are repair categories in river transport that are not included in the PPR system. They include:

restorational, emergency, maintenance and other unplanned repair, and guaranteed repair.

Under restorational repair, typical work is that of putting into operational condition ships that have been withdrawn from the fleet's operating component as a result of having received major damage during a natural disaster or accident (from an ice floe, a fire, a storm, and so on). The dates for performing these operations and the volume thereof and the desirability of carrying them out are established for each ship by the Ministry of the River Fleet at the instance of the steamship line (or the BUP or USK). Reequipping and modernization work can be performed during restorative repair.

During emergency repair, work is done during the navigational season to eliminate damage to structural members that has been sustained as the result of an accident or a breakdown. A report should be compiled on each such case in accordance with the Instructions on Classification and the Procedure for Investigating and Reporting Emergency Transportation Incidents on the Inland Waterways of the RSFSR and be signed by the navigability inspectorate.

Repair work in emergency cases is called for in an amount that will permit the ship to be operated until the end of the navigation season; other work can be done under the routine (winter) repair plan in coordination with the River Registry inspectorate. The procedure and period for performing emergency repair are established by the steamship line's chief engineer (or the deputy chief of the BUP or USK).

Ships that are excluded from the PPR system as a consequence of physical deterioration or obsolescence or the inexpediency of overhaul but remain in the fleet's operating component are subject to maintenance repair. The technical condition of such ships is maintained by performing on them that minimal amount of work that will make them capable of operating for one navigation season.

Other unplanned repair includes work to eliminate during the navigation season minor malfunctions, production (or industrial) failures or deterioration and discovered defects, as well as damage that has been received as a result of transport occurrences that relate to defective parts in operation and that have been formalized by reports that are certified by the ship's owners.

Guaranteed repair is understood to mean the elimination of defects that arise as a result of poor quality of work done or underfulfillment of the approved amount of work on a ship during winter repair.

Chapter 3. Ship-Repair Enterprises

§8. The Concept of the Production and Technological Processes

Ship-repair enterprises are the main production base for carrying out all types of ship repair; they are included among machinebuilding enterprises in accordance with the sort of output produced and the equipment. The operation of each industrial enterprise (machinebuilding) is characterized by a production process, as a result of which materials and semifinished items are transformed into a final product.

The totality of all the actions of the production people and equipment that are necessary at a given enterprise to make or repair the items produced, is called the production process (GOST [State All-Union Standard] 3.1109-73).

The production process of a ship-repair enterprise (also of an industrial enterprise) differs greatly from the production process of a machinebuilding plant. It is more complicated at a ship-repair plant as a result of the need to dismantle, find defects and clean and restore worn parts. The seasonality of navigation in inland waterways means that the main work of repairing the fleet is done between navigation seasons. During the summer the basic workload of ship-repair enterprises is ship overhaul, machinebuilding, shipbuilding and the manufacture of replaceable and spare parts, components and mechanisms. Along with the industrial activity, the enterprises perform technical and housekeeping servicing of the fleet attached to them.

The production process of a ship-repair enterprise includes preparation for the production and manufacture of blanks, parts, components and the assembly and installation of new machinery and mechanisms, as well as the dismantling of mechanisms, the disassembly and repair thereof by replacing worn parts and components with newly made ones, and the assembly and testing of repaired items. Moreover, the production process includes monitoring the quality of the output, the transporting of materials, articles, parts and assemblies from ships to shops for repair and the return thereof after repair, and the storage of finished output in warehouses.

A part of the production process that includes actions for the changing or later determination of the condition of the subject of production is a technological process (GOST 3.4109-73). This process is directly connected with change in the shape, dimensions and physico-mechanical properties of blanks and parts and with the creation of a definite interrelationship among them. A complete part of a technological process that is carried out at one workplace is called a technological operation.

In developing technological processes, the choice of a base for mounting, measuring and assembly is of great importance.

The surface that fastens the part being machined to the machine tools, chucks, clamps, and so on is the mounting base.

The surface from which the size of a part is counted off during a change or during the marking thereof is called the measurement base.

The surface of the part on which its correct placement in the mechanism being assembled depends is called the assembly base. Such surfaces include those of main crankshaft journals, the outer bands of cylinder sleeves, the plane of the cylinder-block base, the piston skirt, and so on.

The technological processes that are worked out and approved by the management of the ship-repair enterprise are entered on flow charts, which are baseline documents for preparing for the production, planning and organization of operations in the department and at the yard, and also for supplying the production activity with materials, blanks, tools and attachments. The flow charts are routing and operational charts and charts for fitting and assembling operations.

Routing charts show a list of operations with an indication of the equipment, attachments and tools employed to carry them out, the place of the work, and the time norms.

Operational charts are used in large-series production or in the fabrication of complicated parts.

Flow charts for fitting and assembly operations contain a list of the parts that make up the components being assembled; they show the composition of the brigade and the qualifications of the brigade members.

Correct organization of production at a ship-repair enterprise assures strict observance by all workers of technological discipline--strict observance of the approved technology and the prescribed specifications for the fabrication, repair and assembly of the machinery, mechanisms, hulls and superstructures of ships.

The observance of technological discipline provides for a normal operating regime, high quality of the product, and the output thereof within the prescribed periods, and it also helps to raise labor productivity and to reduce costs.

§9. The Makeup and Classification of Ship-Repair Enterprises

The ship-repair enterprise is an integrated activity, which consists of: a yard (or repair shops) situated on convenient and adequate land close to a berthage for the placement of ships; a water area (or cove) with a berthage that is protected from ice floes and strong winds and is adequate in depth and area for the placement of the ships attached to the enterprise when water levels in the river are low; ship-lifting equipment that enables repair of the ships' underwater portions; materials warehouses; power-engineering services; a transportation department; and housing and personal-services buildings.

The departments of a ship-repair enterprise are specialized production cost-accounting subdivisions that have the necessary equipment for doing repair work. They are subdivided, in accordance with the type of work done, into preparatory departments, and main and auxiliary departments.

The preparatory departments include those that process raw materials, and their products are semifinished items (blanks) that require further machining in the main departments. The preparatory departments include:

the forging department, which makes mainly forged pieces that require machining;

the casting department, which makes castings of parts of various shapes of ship mechanisms and of shipyard equipment; and

the sawmill and lumber kiln, which produce cuttings of roundwood for planks and squared timber for the wood-processing departments.

The main production departments repair ships and their parts, machine semifinished items that arrive from the preparatory departments, and fabricate new parts and entire components of ships. These departments include:

the boiler-and-hull department, including a welding division, which repairs metal hulls, ship boilers and the superstructure of ships, and also makes new hulls;

the mechanical department, including turning and fitting divisions, which do the cold machining of forgings and castings on metal-cutting machine tools for ships being repaired, and the fitting and assembly of parts, as well as the installation and testing of them on a stand or on ships;

a department for the ships' crews (technical operation), at which ship crews repair machinery and do technical and housekeeping servicing of the attached fleet;

an electrical repair department, which repairs the electrical and radio equipment of ships. Personnel of this department replace and install new electrical wiring on ships and also do auxiliary work on illumination of the wintering-over fleet of ships, and so on;

a wood-finishing department, including carpenters' and cabinetmakers' divisions, which works on the manufacture and installation of wooden parts that become part of the hull or superstructure and the manufacture and installation locally of articles of equipment and furniture, as well as auxiliary operations that are necessary during repair (the fabrication and erection of scaffolding, bridging, cribbing and other items); and

the dock and the canvas, rigging and painting departments, which work on the relocation of ships and the lifting and lowering thereof, the repair

of exterior items and of the rigging, and the painting of ships and of ship equipment.[1]

The auxiliary departments include:

the tool department, which makes special tools, various special attachments, auxiliary tools and dies for forging, and they also repair the yard's tools and sharpen the main cutting tools; and

the repair department of the chief mechanical engineer's section, which carries out the PPR of all yard equipment and performs minor repair of the yard's buildings and structures.

There is a power service, a transport department and materials warehouses for servicing the yard. The power service includes an electric-power station or a stepdown transformer substation, a boilerhouse and a compressor station. The transport and load-lifting equipment provides for the transporting of freight wihin and outside the yard. Ship-lifting equipment (a slipway, a marine railway, a floating dock or graving dock, and other facilities) is set up at the yard to lift ships whose underwater portions require repair. There are warehouses for storing and preserving arriving materials, semifinished items, fuel and finished output on the grounds of the ship-repair enterprise.

The laboratory performs chemical-monitoring analyses and mechanical tests of arriving materials, and it tests and analyzes items that require check of the quality or correctness of the industrial processes used or the composition of raw materials.

The storage facilities and departments are arranged in such a way as to provide for the correct dispatch of traffic loaded with materials, semifinished items, parts, and components and articles to be repaired. The traffic flows should be as short as possible, without crisscrossing movements. So the main departments are situated as close as possible to the berthage of the ship-lifting facilities.

Departments of the preparatory group usually are placed in the second row from the berthage, to allow the semifinished items or blanks from them to be delivered to the main departments quickly and without excessive transporting.

The placement of departments and of production sections on the grounds in a way that will support a rational technological process is called the master plan of the yard (or enterprise).

Ship-repair enterprises are classified according to the following criteria: degrees of complexity of the main production activity, that is, the categories of repair; the types of ships repaired; the region serviced; the

1. Large ship-repair and shipbuilding enterprises have separate departments for ship-lifting, painting and yard transport.

degree of autonomy of the enterprise's production process and the volume of subcontractor deliveries; the volume of construction of ships not produced in series and of small-series machinebuilding; the volume of the production program of ship repair; the manning planned for the year; and the average annual gross output per worker.

The purpose of classification is to establish the importance and role of the separate enterprise in the fulfillment of tasks assigned to the river transport of a given region or basin, which are set by the plans for haulage and by production programs.

Ship-repair yards (SRZ's) are industrial enterprises that have the basic production departments and yard facilities and carry out the complete cycle of technological processes, beginning with the fabrication of blanks for parts to the assembly of the objects of production of ships, machines and so on. Yards perform overhaul, intermediate repair, the modernization and restoration of ships and navigation-season repair, and they fabricate replaceable and spare parts and components.

In addition to ship-repair plants, there are within industrial enterprises of the river fleet ship-repair and shipbuilding yards, machinebuilding plants, ship-repair shops and operational maintenance bases (REB's).

Ship-repair and shipbuilding yards (SSRZ's) have at their disposal the full set of equipped departments and structures necessary for doing all kinds of ship repair and have a reserve of capacity for hull welding and machinery-assembly departments for carrying out a small-series shipbuilding program.

Machinebuilding plants or enterprises have at their disposal the full set of well-supplied preparatory departments and machining departments that is necessary for the series production of machines, mechanisms, replaceable and spare components and parts, and castings, forgings and other semifinished items for satisfying the requirements of Ministry of River Fleet enterprises.

Ship-repair shops (SRM's) are industrial enterprises with the minimum required equipment for machining and assembling ship parts, which operate with an incomplete technological process. They are distinguished from yards by the presence of equipped shops of one of the groups (hull, machining or woodworking groups), depending upon the specialization. The shops in most cases lack casting and forgings departments and ship-lifting structures. The main types of work performed by the shops are the intermediate repair of the nonself-propelled fleet that do not require placement on a slipway, current and navigation-season repair for the self-propelled and nonself-propelled fleet, and the fabrication of uncomplicated replaceable and spare parts for ships not produced serially.

Operational repair bases of a fleet are enterprises that support the normal technical and housekeeping services of ships assigned to them and also perform industrial-activity tasks.

Ship-repair yards and REB's insure the appropriate technical condition of the ships attached to them during the whole navigation season. They should release ships from repair and from wintering-over in good time upon order of the shipping line.

Yards and REB's perform all types of repair of ships assigned to them, as well as modernization work; they do technical servicing of ships with personnel of the BPU [shore operations section]; they supply the ship with navigation-season materials, spare parts, stock, tools, rigging and ship documentation; they make up technical documentation for current, intermediate and navigation-season repair of the fleet; they analyze the wear of important parts of the main and auxiliary machinery, and present a fleet-repair program to the shipping line; they determine the requirements for navigation-season materials, tools, stock and replaceable and spare parts and present requisitions to the shipping line for these types of material provisioning; they work out plans and provide for the execution of unit repair of the fleet; they study the technical conditions of the attached fleet and present to the shipping line proposals for its improvement; they work out measures for reducing expenses for repair of the attached fleet by improving the organization of operations, the use of new materials, and the introduction of new equipment and advanced technology; they man the ships with the common trades (seamen, helmsmen, mechanics and others); they do the planning, reporting and bookkeeping for operations connected with the housekeeping and technical servicing of the fleet; they provide for normal housing and cultural and personal-services support for crew personnel and for enterprise workers; and they make up, with the shipping line's participation, a plan for the use of crew personnel between navigation seasons in accordance with the selection of workers for winter repair, to do the ship repair required of ships' crews and to work in the REB and in yard departments.

In the USSR all machinebuilding and metalworking enterprises, regardless of their agency subordination, are divided into seven groups for pay of managerial personnal and engineers and technicians (ITR's), taking into account the type of production, the complexity of the products produced, worker manning and the annual gross product per workers. In accordance with the indicators referred to, river-transport enterprises are included among the enterprises with individual and small-series production that manufacture especially complicated output; according to this All-Union scale of classification, yards and shops are distributed among groups III to VII (table 2), REB's among groups I to IV:

Wage groups	Personnel afloat and REB workers (persons)
I	More than 1,600
II	150-1,600 [sic]
III	250-750
IV	Fewer than 250

In addition to ship-repair yards, shops and REB's, at certain ports, berthages and technical and operating sections, there are floating repair shops and wintering-over points:

Table 2

Wage group	Worker manning under the annual plan, thousands of persons	Average annual gross output per worker, rubles
III	2.5-5.0	2,700
IV	1.0-2.5	2,400
V	0.4-1.0	2,400
VI	0.1-0.4	2,400
VII	Up to 0.1	Less than 2,400

Because of the climatic conditions over most parts of the USSR, ships operate for 6-7 months.

The water areas of ship-repair yards, repair shops and REB's serve as anchorages for the fleet during wintering-over or repair. They should provide convenient and safe anchorage of the fleet for all river states (freezing over, drift ice, and so on) and all possible variations in water level.

During the winter, the fleet is dispersed over the wintering-over points in accordance with a previously approved plan.

§10. The Management Structure of the Ship-Repair Enterprise

Industrial enterprises have the following management structure (figure 2):

management of the enterprise and of the sections subordinate to it that are in charge of questions of creating the conditions necessary for the enterprise's normal activity; and

technical management and the sections subordinate thereto that are in charge of organizing operations and also of the maintenance and repair of yard equipment and the power-engineering activity.

A technical manager for the fleet is stipulated for a staff that manages a yard with an attached fleet and a department of technical operations, as is the case also for REB's.

Let us examine the functions of the management of the enterprises and divisions.

The yard director (or chief of an REB) is the supervisor of the enterprise, he has all the material and monetary resources at his disposal, and he organizes production on a cost-accounting basis. He provides the conditions required for normal activity for the financing and accounting operations and for monitoring the output quality and safe wintering-over of the fleet being repaired. He is responsible for fulfilling the state plan for the

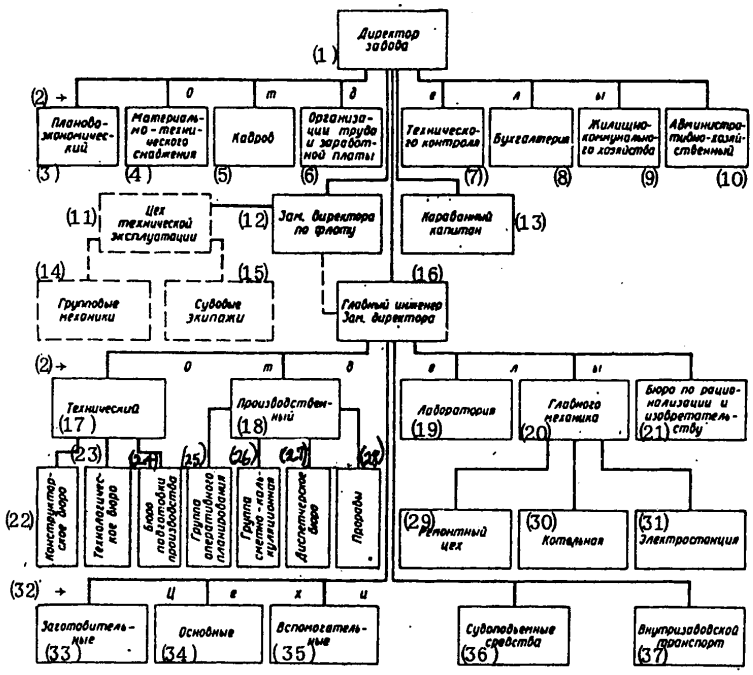


Figure 2. Diagram of the Management Structure of a Ship-Repair Yard That Has a Technical Operations Department.

Key:

1. Yard director.
2. Sections.
3. Economic planning.
4. Supply of materials and equipment.
5. Personnel.
6. Organization of work and wages.
7. Technical monitoring.
8. Accounting.
9. Housing and municipal-services activities.
10. Housekeeping and plant activity.
11. Department of technical operation.
12. Deputy director of the fleet.
13. Harbormaster.
14. Group mechanics.
15. Ship crews.
16. Chief engineer. Deputy director.
17. Technical.
18. Production.
19. Laboratory.
20. Chief maintenance engineer.
21. Office for rationalization and innovation.
22. Design office.
23. Technological office.
24. Production preparations office.
25. Current planning group.
26. Budget-estimate computing group.
27. Controller's office.
28. Superintendents.
29. Repair department.
30. Boilerhouse.
31. Electric-power plant.
32. Departments.
33. Castings and forgings.
34. Main.
35. Auxiliary.
36. Ship-lifting facilities.
37. Intrayard transport.

production of products and for their quality. The following divisions (or groups) are directly subordinate to him:

economic-planning, whose functions include: technical and economic long-range planning, compilation of the tekhpromfinplan [the technical, industrial and financing plan] for the year, the quarter and the month, the establishment of quantitative and qualitative indicators, and analysis of the results of the production-economics activity;

material supply, whose functions are to provide the enterprise with the necessary materials and replaceable and spare parts, to make up annual requisitions for materials and equipment, to acquire and realize funds for materials, to provide for proper storage of materials, and to organize marketing of the enterprise's output;

personnel, which plans requirements for the common trades and for ITR's, organizes large-scale training of personnel, completely mans all elements of the enterprise and of the ships, and hires and discharges workers;

work organization and wages, whose functions include: organization of the introduction of advanced work methods; propagation of advanced experience to lagging sections, assurance of the correct application of technical norms in production, the review of existing and the development of new local time norms, and provisioning for correct use of the wage system as a function of the fulfillment of the norms and of labor productivity;

technical monitoring, which monitors technically the quality of materials and manufactured products that arrive at the enterprise, analyzes the causes of rejects and develops proposals for the prevention thereof at the enterprise, and keeps records of rejects;

the housekeeping and plant activity, whose functions are: protection of the enterprise, the development of rules for the routine in the yard administration and assurance of their observance by the yard's workers, and provisioning of the yard administration with office equipment;

accounting, which monitors the correct expenditure of all monetary and material resources, accounts for production and the operating costs of production, settles with clients and the bank, and pays the yard's workers;

the housing and municipal-services activity, which provides for the upkeep, operation and repair of the enterprise's housing inventory and municipal services;

the harbormaster, who provides for correct upkeep of the enterprise's water area and berthing facilities and safe wintering-over and protection of the fleet being repaired;

the deputy director of the fleet (or deputy chief of the REB), who provides technical and housekeeping services for the fleet attached to the

enterprise and is engaged in organizing ship repair by crew personnel and in manning ships with the common trades; and

the chief engineer, a deputy director of the yard, whose functions are: technical supervision, arranging technical preparation for production and the execution of production tasks, organization of the correct and technically competent operation of equipment and use of production capacity, arranging for the introduction of modern advanced equipment and the creation of safe conditions for operational management of the rationalization and innovation operation, and arranging for the efficient upkeep of the yard activity.

The following sections are subordinate to the chief engineer:

the technical division (preparation for production), which provides for preparation for production, review of designs and drawings for orders that arrive at the plant, the development and design of special tools and attachments for carrying out orders, and the development of technological processes and specifications for acceptance of the product being produced;

the production division, which executes interdepartmental operations planning and centralized control of and accounting for production, makes up monthly and 10-day plans for operations of the yard and departments and for the repair of ships, makes up budget estimates for orders being filled, executes current management of departments through the central control office in providing for fulfillment of the program, and executes current management and technical supervision over lead engineers (superintendents to whom a definite number of ships have been assigned) for production, quality and deadlines for carrying out ship-repair operations;

the chief maintenance engineer, who provides for the maintenance and PPR of all the yard's equipment, for operation and repair of the power facilities, and repair of the yard's buildings and structures;

the laboratory, which performs chemical analyses and mechanical tests of materials and samples of the output produced;

the office for rationalization and innovation, which keeps records on suggestions, implements the rationalizers' measures, and works out projects on the organization and guidance of the rationalizers' work; and

the work-safety engineer, who monitors the observance of the accident prevention rules and develops instruction on accident prevention.

The organizational structure of an REB differs somewhat from that of a yard. At an REB the functions of the economic-planning and production divisions, the personnel division and the division of work organization and wages, and also the administrative activity and housing and municipal services activities, are combined. It has no office for rationalization and innovation.

Because of the complexity of production at large yards, the composition of yard management includes divisions for: finance and capital construction, which are directly subordinate to the director, and a chief power engineer and a chief metallurgist, who are subordinate to the chief engineer.

§11. Management of a Department of a Ship-Repair Enterprise.

There is at the yard, the REB and workshop departments a self-sufficient administrative and production unity that enables the established monthly, quarterly and annual plans to be met.

The department is under a chief, who organizes the managerial and production activity and is answerable for plan fulfillment, output of a high-quality product, and rational use of the department's equipment and material valuables, as well as for the creation of normal and safe working conditions for the workers and for strict observance of the standards, specifications and technological processes.

In order to provide for normal activity for the department--planning, norm-setting for operations, centralized control, organization of the work of the wage workers, and observance of the technological processes--the managerial staff includes: an engineer (or technician) planner, a production engineer, an engineer (or technician) norm-setter, a controller engineer, and a foreman. The number of ITR's can vary, depending upon the nature and complexity of production. The departments of large enterprises are more complicated in structure.

The engineer (or technician) planner, under the supervision of the yard's production section and the department chief, does the intradepartmental planning and makes up 10-day and daily-shift plans for production sections and brigades.

The production engineer's responsibilities include the introduction of advanced technology into the department and assurance of strict observance of approved technological processes in carrying out the work.

The engineer (technician) norm-setter is engaged in setting technical norms (the computation of cost) of operations carried out by the department, being guided, in so doing, by approved unified and local time norms, wage-category scales, materials-consumption norms, and price lists for materials. He makes up work orders, which he hands over to the working brigades or to individual workers.

The centralized production control engineer exercises general supervision over preparatory operations at workplaces in accordance with the approved schedule and monitors their fulfillment.

The foreman is the main organizer of the operations of the workers' brigades and is responsible for plan fulfillment for the section he leads, both as to quantitative and qualitative indicators.

There are in river transport a large number of enterprises (and REB's and repair shops) where, if operating volume is relatively low, the departmental form of managing production creates a multiplicity of levels and leads to an excessive number of departmental personnel. More often encountered are departments in which production workers number about 30-40, and a department chief and shop foreman supervise them. Where this situation exists in a department, the foreman's role as a central figure for production is diminished.

In recent years RSFSR Ministry of the River Fleet has been introducing a department-free structure for managing production at some small enterprises. The essence of this structure consists in organizing specialized production sections instead of departments, through which production is managed. The foreman is the section manager.

Plant-management divisions perform all the industrial preparation for production and the planning and accounting for the work of the production sections, and they also set the norms for the labor of the workers. Under such a structure, the foreman aims all his knowledge and experience at solving production tasks, the management of production is simplified, and substantial economic benefit is obtained where production volume is small.

Chapter 4. Preparation for and Planning of Ship Repair.

§15. The Essence of Organizational and Technical Preparation for Ship Repair.

Preparation for ship repair includes a major set of operations: discovery of the technical condition of ships, making up technical documentation (designs, budget estimates, working drawings, technological processes, and repair lists), the fabrication of replaceable parts and tools and attachments, the repair of yard equipment, and other work.

Modern organization of repair of a fleet requires a strict system for planning operations and thorough preparation for their execution. The shipping lines (or the BUP's) and ship-repair enterpises make preparations in the period prior to ship repair.

In the period of preparation for ship repair, the shipping lines (and the BUP's and USK's) define more accurately the place of repair for ships that are subject to current, intermediate and maintenance repairs and work out a plan for the breakdown by repair base; they prepare lists of interchangeable and spare parts that are subject to fabrication during the navigation season; they check, refine and approve the repair lists and draw up the financing; they develop plans to prepare the enterprises for making winter repairs and schedules for putting ships into repair, and also schedules for placing the ships on slipways or in graving docks.

For ships that should be delivered for overhaul and restorational repair, schedules for preparing them for repair, for outfitting them, for

preparing documentation and for conducting the repair are worked out; a preliminary and prerepair survey of the ship's defects is made; technical tasks and contract designs are worked out and approved (by personnel of the central design office); and lists of replaceable mechanisms, equipment, components and parts, and budget-estimating and financial calculations and technological appraisals are made up.

During the period of preparation for the forthcoming repair between navigation seasons, ship-repair enterprises do a large amount of work to manufacture or acquire replaceable parts, to make up complete sets of equipment and structure for ships, and to place ships on slipways or in graving docks in accordance with the tasks of the shipping lines (or BUP's and USK's). All this comprises the zero stage of ship repair. Thus, as much as 40-45 percent of the ship-repair work is done before repair between navigation seasons starts; this, to a great extent, facilitates repair and preparation of the fleet for the next navigation season.

Ship-repair yards, REB's and workshops, prior to the start of the period that separates the navigation seasons, obtain operations plans approved by the higher organization and, in accordance with it, ready themselves for reception of the fleet and for execution of the forthcoming ship-repair work.

The Ministry of the River Fleet establishes by appropriate orders the periods for fulfillment of work on preparation of the industrial enterprises for winter repair. During these periods the ship-repair yards, the REB's and the workshops are required: to manufacture in series, or individually, the large replaceable parts that are necessary for the forthcoming ship repair; to repair the buildings of departments, the production equipment, and the ship-lifting and transporting equipment; to prepare the yard's water area and shore land for the safe deployment of the ships; to clear up and deepen the water area (or cove), and to clear and clean up the grounds; to repair the housing inventory and the cultural and personal-services institutions for the personnel afloat; to make up a plan to provide the ship repair operation with a work force, taking into account use of members of the ships' crews; to obtain materials, equipment, tools, semifinished items and articles manufactured by other enterprises in accordance with the funds allocated to the enterprise and to get them to the enterprise on time; to make out cost analyses of the repair lists, in accordance with the lists that have been received for ships that are subject to repair during the winter, to find out the work volume and to take measures to provide a work force; to make up a plan to distribute the whole fleet over the water area and to coordinate it with the fire department; to conclude a contract with the fleet owners (the shipping line administration, and the BPU's and USK's) for doing the work; and to work out technological processes for the labor-intensive operations.

§16. Technical Documentation for Ship Repair.

The compilation of technical documentation should be preceded by a thorough inspection of the ship in order to find out more about its operating

condition and the categories of the impending repair. In so doing, the requirements of monitoring organs (the Registry, the VOKhR, and others) must be considered.

Repair lists are made up for the performance of current, intermediate and maintenance repair of self-propelled and nonself-propelled ships in accordance with the ship-repair rules. Overhaul and restorative repairs of ships, as well as major modernization work, are performed in accordance with technical tasks and contract designs in accordance with individual budget estimates. Modernizing work is done in accordance with unified standard designs and budget estimates.

The repair list is the basic budget-estimating, planning and technological documentation that determines the amount, nature and cost of repair work that should be carried out on a ship. It specifies all the repair work and indicates the labor intensiveness by trades and breakdowns of workers, the amount of materials required, the cost of the work and the total cost for repairing the ship, taking into account the preparatory operations and the manufacture of replaceable parts, components, mechanisms and equipment.

Individual repair lists are made up in river transport for ships that were not built in series and are subject to maintenance repair. The administration of the ships makes them up, and after this they are subject to refinement, cost computation, and approval. Unified lists are compiled previously for serially produced ships of like type. The ship's administration needs only to specify precisely the actual amount of the work.

Repair lists for ships not produced in series are subdivided into main and supplemental lists. The main list is made up for current and intermediate repair of self-propelled ships and suction dredges. For intermediate repair, a list is compiled by 10 April of the year that the ship repair starts, for current repair by 1 August. The list for additional supplemental repair is made up in 10-15 days after delivery of the ship for repair. One list for the current and intermediate repair of nonself-propelled ships is made up by the date of the delivery thereof to the repair facilities.

Lists are made up separately for the hull and mechanisms. In so doing, if part of the work on a ship is to be done by crew personnel, then a special list is made up also for them, for the hull and the machinery division.

The basis for making up the repair list comprises: scientifically developed norms for the repair of mechanisms, components and parts of ships; the data of systematic observation of the technical condition of mechanisms, equipment, components and parts of the ship during operation and repair; and notations and additions to the ship's official descriptive documentation about the results of technical inspections and observations, reports of inspection of the ship, the requirements of supervisory organs (the River Registry, VOKhR and others) that were presented at the time of the previous repair, the norms for permissible wear of parts, mechanisms

and hull members that have been approved by the Ministry of the River Fleet, and the results of observation of mechanisms by the ship's administration.

The list of repairs for the hull is made up by the captain or his senior assistant (the boatswain's storekeeper or the commander of a suction dredge), and, for the mechanical portion, by the ship's engineer. On ships that operate with personnel who engage in more than one occupational skill, the repair list is signed by the engineer-captain of the ship (or the engineer-commander of a suction dredge).

Before it is transmitted to the ship-repair enterprise, the list is checked and refined by the group mechanical engineer. After this the repair list is approved by the chief or acting authorized representative of the SSKh for the cost calculations. All the work on checking and coordination of the cost calculations of the main lists for the intermediate repair of self-propelled and nonself-propelled ships with power plants should be done by 15 April, and for the current repair of self-propelled and nonself-propelled ships with power plants by 15 August, of the year that the repair starts. The lists should be transmitted to the ship-repair enterprises by these dates.

After delivery of the ship for repair between navigation seasons, defects that were not specified in the main list that should have been eliminated during the preceding repair period may be observed during disassembly of mechanisms and inspection of the hull. In accordance with the ship-repair rules, the operations to eliminate these defects should be considered in a supplemental repair list which, just like the main one, is made up by the ship's administration, checked by the group engineer, coordinated with the chief or authorized representative of the SSKh, and transmitted to the ship-repair enterprise for cost calculations.

The search for defects that is made prior to repair and the compilation of supplemental lists are performed in 10 days after receipt of the ship in the case of current repair, in 15 days in the case of intermediate repair, and in a month in the case of overhaul.

While repair is being performed, work not foreseen in the repair lists frequently is discovered. In order for such work to be performed, the lists for current and intermediate repair call for a reserve. The repair is performed in accordance with separate requests, which should be presented by the ships' administration no later than a month prior to bringing them to technical readiness. Requests for said work are accepted for execution only with the authorization of the enterprise chief engineer--the performer of the work. Carrying out the additional work should not affect the ship-repair enterprise's operating rhythm.

§17. Examination and Cost Calculation of the Repair Lists by Enterprises

Ship-repair enterprises review and refine the main and supplementary repair lists that arrive for cost computations and make the necessary refinements

and changes thereto. The changes introduced should be approved by the shipping line. The enterprises are required to execute all work on the review and refinement of the repair lists within 15 days after receiving them.

The ship-repair enterprise does the cost computations, that is, it figures the cost of the repair for each individual repair list on the basis of approved lists of wholesale prices for ship-repair operations. The wholesale price list is a collection of previously determined overall costs that are characteristic of the work on current and intermediate repair and overhaul of each mechanism and assembly. It also specifies the cost of operations for the fabrication of various parts of machines and mechanisms. Where wholesale prices for the operations enumerated in the listing are lacking, then the cost is computed in accordance with approved unit norms for time and consumption of materials that are in effect at the enterprise, the rates handbook, and the schedule of materials and cost of blanks received through suboontracted shipments, and also in accordance with the supplementary wages, the deductions based thereon, and the departmental and overall plant expenditures that have been approved for the given enterprise.

Ship-repair enterprises are obligated to complete computation of the main lists for the intermediate repair of self-propelled and of nonself-propelled ships with power plants not later than 15 June of the year that the repair starts and of nonself-propelled ships of other types in 15 days from the date of their delivery for repair; and, for current repair, respectively, prior to 1 September of the year that the repair starts, and in a 10-day period from the date of receipt of the ship for repair; and computations of budget estimates for overhaul and restorative repair of ships are to be completed 9 months prior to start of the work.

Ship-repair enterprises should make the cost calculations for supplemental lists for current and intermediate repairs in 10 days, for overhaul in 15 days, from the time of receipt of the list.

A representative of the shipping line's SSKh thoroughly checks the repair list (or the budget estimate) computed by the yard (or workshop). After verification of the calculation and final concurrence with the ship-repair enterprise on all questions on budget estimated cost of the repair work, individual repair lists (or budget estimates) are approved regardless of the category of repair or sources of financing; where the cost of repair is less than 50,000 rubles--by the ship's owner; where it is 50,000 to 100,000 rubles--by the chief of the steamship line (or of the BUP or USK), where it is 100,000 to 200,000 rubles--by the chief of the main administration of the Ministry of the River Fleet, and where it is more than 200,000 rubles, by the management of the ministry.

The repair lists (or budget estimates) should be approved within the periods: by the fleet owner--within 15 days, and by the ministry--within 1 month, from the date of receipt from the shipping line (or the BUP or USK). Approved lists (or budget estimates) are transmitted to the

ship-repair enterprise that executes the repairs not later than 1 October of the year the repair starts for current repair, not later than 10 July for intermediate repair of self-propelled ships and of nonself-propelled ships with power plants, and 7 months prior to the start of repair for ships to be overhauled.

The compilation of individual main and supplemental lists of repair, their examination, refinement, calculation of costs, and approval take up much time, the amount and cost of the work for each ship being computed separately.

For serially produced ships, unified repair lists have been compiled and published, based upon the mix and amount of basic repair operations established for PPR conditions. Current or intermediate repair of serially produced ships is performed for each category of each type in accordance with the unified repair list (YeRV). Under this system, the need for captains and engineers to compile repair lists for serially produced ships and to further refine and analyze the cost of the work in accordance with unified time norms is done away with.

The unified repair list is a finished budget-estimating industrial document that contains:

a list of repair operations set forth in the form of a breakdown of the ship into technological complexes with an indication of the items of the object being repaired and the estimated amount of work;

data about the necessary work force per unit and estimated amount of the main operations, with an indication of the specialty and skill rating of the executor of each operation;

data about the necessary materials, semifinished items and replaceable items, with an indication of the amount of the basic materials per unit and the estimated volume of operations;

data about the wholesale cost of each type of operation;

consolidated data about work-force expenditures and cost of repair, broken down by technological complexes;

a list of replaceable parts delivered in the centralized procedure;

a list of the required castings; and

a consolidated list of the required materials.

During the navigation season, the captain and the engineer should, using the established procedure, refine the amount of work for the list and make the necessary amendments to it.

Additional work should be formalized in accordance with the Rules for Repair of Ships of the Ministry of the River Fleet. Supplemental lists for the YeRV are calculated in accordance with unified settlement terms (wholesale prices and yard norms).

The total (wholesale) cost for ship repair under the unified repair list also includes, aside from the operations enumerated therein, the supplemental operations discovered during refinement of the list.

The cost of the additional operations should not exceed 7-10 percent of the cost of the main operations called for in the list.

Costs for the repair of serially produced ships that have been refined in accordance with the YeRV are approved by the enterprise manager for current repair and the fleet owner, and, for a fleet that is assigned for technical and housekeeping service of the given enterprise--by the manager of the enterprise; and for intermediate repair--by the owner of the fleet.

§18. Designs and Budget-Estimates for Overhaul and Restorative Repair and for Modernization

Designs and cost estimates are made up for all overhaul and restorative repair work performed that change the existing structure or size of a ship's main components. In accordance with the rules for repair, overhaul and restorative repair of ships or major modernization work may not be undertaken without approved designs and cost estimates.

A design bureau develops designs for overhaul and restoration work on a ship on the basis of an engineering task made up by the fleet owner. It shows the amount of and requirements laid on repair of the ship, data of the ship's official descriptive document, and dates of repair, placement in a graving dock or on a slipway, it indicates the technical condition of the hull, superstructure and mechanisms, and it also enumerates the changes that should be called for in the design of the hull, superstructure and other ship elements, and what technical and operational indicators the ship should possess after repair. Engineering tasks and budget estimates for the repair of serially produced ships are worked out in a centralized procedure by scientific and design-development organizations in accordance with the tasks of the main administrations of the ministry and are confirmed by the ministry's management.

Engineering tasks for the overhaul and modernization of ships not produced serially are developed by the shipping lines (or the BUP's or USK's) and approved simultaneously with the budget-estimates and financing calculations for the preparatory work: where the cost of the repair is less than 50,000 rubles--by the ship owner, less than 100,000 rubles--by the chief of the shipping line (or the BUP or USK), less than 200,000 rubles--by the chief of the ministry's main administration, and more than 200,000 rubles--by the ministry's management.

In order to make up correct engineering tasks for overhaul and restoration repair, ships are put on a slipway and, in so doing, a detailed list of defects is made up. During the inspection of the hull prior to repair, participation of a River Fleet inspector and a representative of the yard that will repair the ship is mandatory. Attached to the engineering task is the report of the inspection of the ship, a sketch of the plating brace, construction sketches and diagrams, the official descriptive document of the engineering equipment, data about the heat-engineering and dynamometer tests, and the specifications for major parts and of the outfitting equipment, as well as computations that confirm the economic desirability of making the repair.

Simultaneous with compilation of the engineering tasks for overhaul or restorational repair, the shipping line makes up a budget estimate and financing calculations for doing the work preparatory to ship repair. These call for expenditures for the preliminary drydocking, design, the fabrication and acquisition of mechanisms and large replacement parts, lifting of the ship on shore, and the execution of other preparatory work.

The total expenditures under the budget-estimate and financing calculations should not exceed 40 percent of the cost of the repair, which is determined in accordance with the preliminary consolidated calculation or according to measurements.

The budget-estimating and financing computations are presented for approval simultaneously with the engineering task for doing the overhaul or restorative repairs on the ship. The approved budget-estimating and financing calculations are the basis for finding financing.

The technical tasks for making restorative repair are developed for each ship separately. They should contain a calculation of the desirability of the restoration of the ships. The cost of restorative repair in this case should not exceed 60 percent of the cost of the ship. The technical tasks, budget estimates and budget-estimating financing computations for restorational repair is approved by the chief of the ministry's main administration where the cost of the repair is less than 200,000 rubles, and by the ministry's management where the cost is 200,000 rubles or more.

For overhaul, restorative work and large-scale modernization work, contract designs should be developed and presented for confirmation prior to the start of overhaul or repair of the ship.

The contract design includes: the engineering task for the design, overall ship specifications, a theoretical sketch, sketches of the general layout, and computation of buoyancy, initial stability and unsinkability; structural drawings, calculations of local and overall strength; calculations and basic diagrams of the ship's devices and of overall ship systems; calculations and drawings of the propellers; calculations, diagrams and sketches of the layout of the main and auxiliary machinery and pipelines for the machinery and boiler division; calculations and sketches of the steam boilers; schematic diagrams and sketches of the power, lighting and

emergency grid; sketches of the radio equipment; diagrams of shipboard communications and control instruments; the main technical and economic indicators of the ship's operation prior to and after the repair; lists of the orders for materials and equipment, replaceable parts, large forgings and castings; and lists of the ship's supplies and stock.

Standard technical designs are being developed for the overhaul of serially produced ships. Repair is carried out in accordance with the standard working drawings and standard technological documentation. The design bureaus of those ship-repair yards at which the ships will be repaired usually make up the working drawings for execution of the contract designs.

The requirements of the monitoring organs should, in accordance with the ministry-established procedure, be presented for ships intended for overhaul or restorative repair no later than a year prior to start of the repairs. Each contract design for overhaul and restorative repair should be coordinated with supervisory organs during development. The designing organization bears responsibility for the quality and completeness of the design.

Designs that have been developed for overhaul and restorative repair are subject to mandatory approval. In accordance with the rules for ship repair, shipping-line chiefs have been granted the right to approve designs where the cost of overhaul or restorative repair is less than 100,000 rubles. If the repair work will exceed this amount, then the design should be approved by the chief of the ministry's main administration.

Designs for overhaul and restorative repair of ships are transmitted to the ship repair yards for the compilation of budget estimates. The latter are compiled on the basis of approved contract designs or engineering tasks, after the cost analyses have been subjected to expert review and approved.

Serially produced ships are overhauled in accordance with the engineering tasks and unified budget estimates for repairs that are obligatory for all the ministry's enterprises and organizations. Additional work discovered during overhaul that was not included in the unified budget estimate is done through a reserve called for by the budget estimate within the limits of the established cost.

§19. The Planning of Ship Repair

In accordance with the Rules for the Repair of Ships of Ministry of the River Fleet, the amount of repair, modernization and reequipping of the fleet is determined by the ship-repair plan, which is part of the unified plan for the development of river transport. Ship repair should be planned with complete observance of the PPR system. Ship-repair plans are made up for the long term (for several years) and annually (current plans).

The directives and control figures of higher organizations about trends in the development of river transport, the standards for periodicity of PPR of ships, and the guidelines adopted by the Ministry of the River Fleet for introducing new equipment on ships and in the ship-repair industry are the basis for making up the long-range plan.

When developing long-range plans for repair of the fleet, the technical condition and the age composition of the fleet, the fleet inventory and gains and losses thereof are considered. Long-range plans are made up by type of fleet, taking into account the periodicity of putting ships on slipways, and the necessity for replacing the main and auxiliary machinery and for other operations. These are developed to take into account the requirements of the River Registry with regard to providing for the safety of navigation and the preservation of a high operating condition of the fleet, and also the requirements of overseeing organizations (sanitary inspection, the labor safety and accident prevention section, the VOKhR, and others).

The long-range plan for ship repair specifies not only maintenance of the fleet in normal operating condition but also the workload of the industrial enterprises (ship-repair yards, workshops and REB's). Simultaneously with development of the plan for repair of the fleet, development of the repairing enterprises and wintering-over bases is specified.

The long-range plan considers: the types and categories of repair that each ship should be subjected to during the plan period, broken down by year; the cost of the repair work and the place of repair; and the requirement for basic mechanisms and equipment subject to replacement during repair (engines, auxiliary mechanisms and so on).

The long-range plans are made up by the planning divisions of the shipping lines (or of the BUP's or USK's), according to the data of the ship-repair organizations, and SSKh's and the industrial enterprises' divisions, in accordance with the forms and deadlines established by the Ministry of the River Fleet and the shipping lines (or the BUP's or USK's), and they are presented to the main administration to which they are subordinate. Here the plan is checked and refined, and a comprehensive long-range plan for repair of the fleet is developed for the ministry jointly with the economic planning administration (PEU). Plans for repair of the fleet should be coordinated with the plans for financing and for the supply of materials and equipment.

The plan for developing river transport, a component part of which is the plan for ship repair, is examined by the ministry's board and is presented to Gosplan and the government. When the plan approved by the state is received, it is reported to the shipping lines and the BUP's (or USK's) for implementation.

The annual ship-repair plan is developed on the basis of tasks (control figures) which the ministry issues to the shipping lines and the BUP's (or USK's).

The ministry reports the annual plan's control figures for current and intermediate repair, overhaul and restorative work and for work on the modernization of ships to the shipping lines (or BUP's) not later than 1 March, and the latter reports this to the ship-repair enterprises not later than 15 March, of the year preceding the plan year.

The fleet owners (the steamship lines and the BUP's), develop drafts of schemes for annual ship-repair plans on the basis of the approved long-range plan, taking into account the refinements for the plan year: data about the technical condition of the ships as determined by reports of the examination thereof; actual implementation of the PPR schedule of the shipping lines (and BUP's); quantitative changes in the composition of the fleet; and the main measures for introducing new equipment and for reequipping that are subject to fulfillment during repair in the planned year.

The shipping line (or BUP or USK) submits the draft of the annual ship-repair plan to the PEU and a copy thereof to the ministry's main administration, according to its subordination (Glavflot [Main Administration of the Dry Cargo Fleet] or Glavvodput' [Main Administration for Waterways and Hydraulic Engineering Structures]) by 1 April of the year preceding the plan year.

Between navigation seasons the drafts of plans for the assignment of ships for the wintering-over period and for repair, which are among the chapters of the annual ship-repair plan, are compiled to take into account the permanent attachment of ships to repair installations. The draft of plans for assignment of the fleet for winter repair is presented, together with the draft of the repair plan, to the main administration of the ministry to which it is subordinate. The place of permanent wintering-over for individual ships attached to an enterprise can be changed when the repair thereof requires the presence of a production potential that does not exist at the installation of permanent attachment, or where ships are transferred from one basin to another. The economic-planning administration, jointly with Glavflot and Glavvodput', work out a consolidated plan for the ministry and present it for approval to the management of the ministry.

The preliminary plan for ship repair, in terms of real output and in monetary terms that the ministry approves, are delivered to the shipping lines (or BUP's) not later than 1 July, and the latter delivers them to the enterprise by 15 July, of the year preceding the plan year.

§20. Financing Ship Repair

In parallel with the compilation of the annual ship-repair plan, the shipping lines (or BPU's or USK's) work out an annual plan for financing ship repair. It is part of the overall annual financing plan and is presented to the appropriate main administrations of the ministry along with the annual ship-repair plan. Expenditures on the current repair of ships are one of the types of operational expenditures of shipping lines (and BUP's and USK's). Current repair is performed through appropriations called for

by the budget estimates for operational expenditures of the shipping lines (or BUP's or USK's). The ministry sets the total sums of annual expenditures for current repair for all classes of the river fleet (transport and auxiliary service) in amounts that are about 5-6 percent of the total of the expenditures under the budget estimate for the basic activity of the shipping lines (or BUP's or USK's) that have been called for under the annual plan for the year that precedes the ship repair.

The Ministry of the River Fleet establishes at the start of the year that precedes the ship repair the control figure on expenditures for the current repair of ships for each shipping line (and BUP and USK) and communicates them to the shipping lines (and BUP's and USK's), together with the control figures for the ship-repair plan.

The shipping lines (and BUP's and USK's) distribute, within the limits of the total appropriations allocated them for repair, ceilings for the individual ships, part of the allocated appropriations being left here as a reserve for the shipping line (or BUP or USK), for distribution among ships while the ship repair is being carried out.

The plan calls for expenditures for maintenance-type repair of ships and fall and spring technical servicing, as well as the execution of simple unplanned repair during the navigation season, through special appropriations in accordance with the budget estimate for the operational expenditures of the shipping lines (or BUP's or USK's).

Intermediate repair and overhaul, the planned placement of ships on slipways, the dismantling and installation of equipment being repaired and the transporting thereof to the place of repair and back, the maintenance upkeep of the ships and portions of the crews during the repair period, design and budget-estimating work, and the fuel and lubricants consumed when ships are tested are to be financed through a portion of the annual depreciation that the shipping lines (and BUP's and USK's) deduct and deposit in a special account in Gosbank.

Restorative repair of ships and the acquisition of engines, mechanisms and components for the creation and expansion of an exchange inventory are financed through funds specially allocated for the fleet's centralized capital investment. The upkeep of the ship and the portion of the crew that monitors the repair, the acquisition of the fuel and lubricants needed for the preparatory work and for testing after repair, the design and budget-estimating and research work connected with the repair, the equipping of ships with systems for protecting bodies of water and the environment from pollution, the acquisition and fabrication of boats, and the acquisition of rigging and radio-navigation equipment are financed through this same capital investment.

The modernization (or reconstruction) of ships, ship machinery and various components, including design, budget-estimating and research work, is done through resources of the fund for developing the production of the enterprise--the fleet owner.

The Ministry of the River Fleet releases funds for restorational repair to the shipping lines (or BUP's or USK's) in accordance with the approved plan for centralized capital investment. Stroybank finances these operations.

Gosbank issues loans (or credits) for expenditures for preparation for ship repair, for the acquisition and fabrication of replaceable units, components and parts for current repair, and for the financing of intermediate repair and overhaul, and also for restorative repair, in accordance with existing Gosbank and Stroybank instructions.

The approved list of titles of projects for intermediate repair, overhaul, restorative repair, and the modernization and reequipping of ships, the repair lists for current repair, and the agreements that are concluded by the ship owners and the enterprises that do the repair are the basis for opening up ship-repair financing. The shipping lines (and BUP's and USK's) approve the lists of titles of projects for operations that are carried out through depreciation deductions. For operations carried out through capital investment, the PEU's of the ministry make up lists of titles of projects for submission to the shipping lines (or the BUP's and USK's), and the ministry approves them.

Outlays for repairing and modernizing the fleet do not include expenditures: for cleaning, dismantling and bringing ships to winter layover status, for wintering the ships and for upkeep of the wintering-over contingent during the repair between navigation seasons; for wages of the ship's crew while repair work is being done that is included in their navigational responsibilities; for operations carried out by the BPU; for fuel and lubricants expended when ships are dismantled and equipped (except for overhaul and restorative repairs); for upkeep of the ship crews during the period of ship dismantling and equipping (except for overhaul and restorative work); and for elimination of the consequences of accidents and emergency occurrences.

The budget-estimating and financing computations for preparatory operations include:

for overhaul--preliminary placement of the ship on the slipway to determine its technical condition and to locate defects of the underwater portion of the hull; design and compilation of engineering tasks, design sketches and contract designs for the budget estimates and working drawings; and the acquisition of mechanisms and the fabrication of various ship elements; and

for restorative repair--raising the sunken ship, and the auxiliary and design work related to raising it; towing the ship to the repair base; placement of the ship in a graving dock (or lifting it onto a slipway) for examination and detection of defects; compiling and approving design and budget-estimating documentation for restoration of the ship; and acquiring complete sets of equipment and fabricating various ship elements.

This preparatory work prior to approval of the budget estimate is financed in accordance with budget-estimating and financing calculations, the total of which should not exceed 40 percent of the full cost of a ship's repair.

Settlements for the completed repair of ships as a whole or for separate components thereof are made in accordance with the budget estimates for the amount of work actually done in accordance with the cost established by the repair list, by budget-estimating and financing calculations and by the price list or by wholesale prices. Intermediate payments for the repair of ships or of separate components thereof are formulated in accordance with the degree of readiness and in percents of the labor intensiveness of the repair.

§29. The Prescribed Schedule for Ship Repair and Calendar Planning

Ship repair is primarily seasonal in nature in river transport. Current and intermediate repair of the fleet usually coincide with the wintering-over period. Fleet owners must provide for the repair of a large number of ships in the comparatively brief period between navigation seasons.

For purposes of organized conduct of ship repair between navigation seasons, a prescribed schedule for ship repair (figure 7) is approved by the river-fleet ministry. It establishes the beginning of ship repair and the deadline for the completion thereof for the various shipping basins, since the duration of ship repair therein is not identical. For example, in the Northern Basin, ship repair starts, according to the prescribed schedule, at the end of October and completion is at the end of April. For the Southern Basin, only about 4 months are stipulated for the total time that ships are to spend in repair--from December through March.

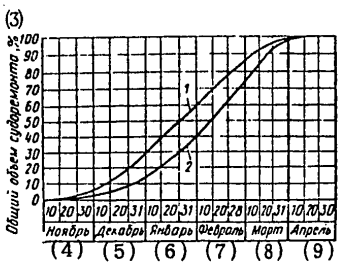


Figure 7. A Prescribed Schedule (an Example) for Current and Intermediate Repair of Ships.

Key:
1. For self-propelled ships.
2. For nonself-propelled ships.
3. Total volume of ship repair, percent.
4. November.
5. December.
6. January.
7. February.
8. March.
9. April.

The fleet is repaired in accordance with a calendar plan and a calendar schedule. Calendar planning requires that departments be provided with technical documentation--drawings, rough sketches, flow charts, materials specifications, labor expenditure norms, and so on. The calendar plan enables the calendar dates for repair of ships to be coordinated with the yard's production program and the throughputs of the various departments.

Calendar planning at a ship-repair yard envisions: the computation of calendar schedules for the work to be done on ships that are being

repaired, which is coordinated with the workload of the departments and with their throughput capability; the development of planned schedules for operation of the various departments by the month, 10-day period and the day, taking into account the correct use of manpower, the yard's production capacity, and fulfillment of the schedules for operations for the various facilities; the issuance of supply authorizations to departments for doing the work; planning and monitoring of the preparation of materials for production; and current centralized control of production and current reporting and monitoring of fulfillment of the ship-repair plan.

A calendar schedule is made up on the basis of the repair lists, the flow charts and the prescribed schedule for fulfillment of repair for each ship, taking into account breakdowns of the repair work into technological complexes. This schedule indicates the most expedient technological sequence for doing the work on a given ship, the deadline for completing the repair, and so on.

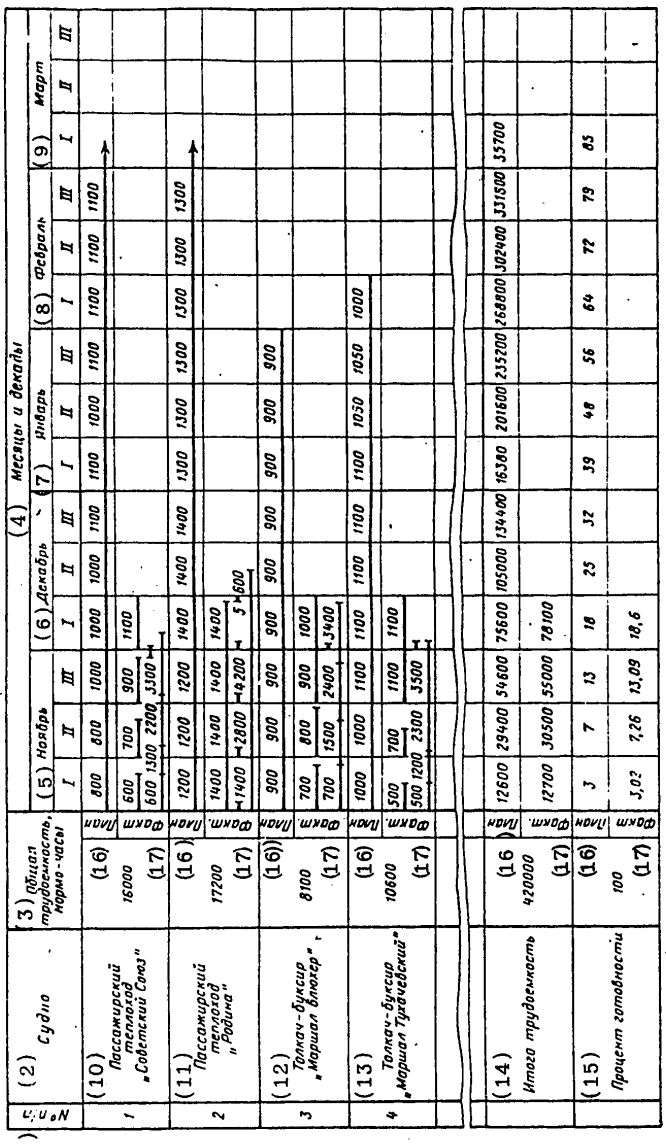
Various ships are grouped for sequence of repair in accordance with the repair schedule, and a calendar group schedule for winter ship repair, which includes ships assigned in a single sequence according to deadlines for turnover, is prepared. Dates for starting and completion of dismantling and disassembly, forging and casting work, machining, and assembly and installation operations are defined for each ship of a given group and for its structural elements.

In breaking down ships by sequences of repair, the first group should include ships with high operating volume. The calendar schedule considers strictly the sequence in carrying out each type of work, for example, the casting, forging, turning, assembly and installation operations are strictly specified in order to provide for a uniform workload of the corresponding yard departments during the winter period.

After development of the group schedule for ship repair for the period between navigation seasons, a consolidated schedule for repair of the fleet is made up, which shows the entire amount of repair work (figure 8). The order for carrying out repair is established on the basis of the group schedule.

Monthly planning schedules for the workload of the departments and various production sections are made up in accordance with the data of the general schedule, so the yard's departments and the yard as a whole will work rhythmically. Dates and procedures for delivery of materials, parts and components, and dates for the start and completion of work are stipulated, as well as the coordination thereof among the various sections.

The plant's production division (or the REB's production planning division) should give the department the monthly task (the monthly program) no later than the 25th of the month preceding the planned month, in order to provide for fulfillment of the plan-schedule. Department personnel are obligated to be thoroughly prepared for the next month's operations. The task is a list of the given department's operations, based upon the repair



(1) № п/п	(2) Судно	(3) Общая трудоемкость, норма-часы		(4) Месяцы и декады: (5) Ноябрь I	(5) Ноябрь II	(5) Ноябрь III	(6) Декабрь I	(6) Декабрь II	(6) Декабрь III	(7) Январь I	(7) Январь II	(7) Январь III	(8) Февраль I	(8) Февраль II	(8) Февраль III	(9) Март I	(9) Март II	(9) Март III
	(10)	(16)	План	800	800	1000	1000	1000	1100	1100	1000	1100	1100	1100	1100			
1	Пассажирский теплоход "Советский Союз"	16000	Факт	600	700	900	1100											
				600	1300	2200	3300											
	(11)	(16)	План	1200	1200	1200	1400	1400	1400	1300	1300	1300	1300	1300	1300			
2	Пассажирский теплоход "Родина"	17200	Факт	1400	1400	1400	1400	5	600									
				1400	2800	4200	4200											
	(12)	(16)	План	900	900	900	900	900	900	900	900	900						
3	Толкач-буксир "Маршал Блюхер"	8100	Факт	700	800	900	1000											
				700	1500	2400	3400											
	(13)	(16)	План	1000	1000	1100	1100	1100	1100	1100	1050	1050	1000					
4	Толкач-буксир "Маршал Тухачевский"	10600	Факт	500	700	1100	1100											
				500	1200	2300	3500											
	(14)	(16)	План	12600	29400	54600	75600	105000	134400	16380	201600	235200	268800	302400	331500	35700		
	Итого трудоемкость	420000	Факт	12700	30500	55000	78100											
	(15)	(16)	План	3	7	13	18	25	32	39	48	56	64	72	79	85		
	Процент готовности	100	Факт	3,02	7,26	13,09	18,6											

Figure 8. Consolidated Calendar Repair Schedule.

1. Sequence number.
2. Ship.
3. Total labor productivity, norm-hours.
4. Months and 10-day periods.
5. November
6. December.
7. January.
8. February.
9. March.
10. Passenger motorship "Sovetskiy Soyuz."
11. Passenger motorship "Rodina."
12. Pusher tug "Marshal Blyukher."
13. Pusher tug "Marshal Tukhachevskiy."
14. Total labor productivity.
15. Percent of readiness.
16. Plan.
17. Actual.

lists that were included in the schedule or the supply authorization for the complex of operations set by the schedule.

The monthly task received by the department (or the monthly program) is spelled out in detail, all operations are assigned to definite sections and broken down by brigade, the workload for machine tools is established, and 10-day and daily plans are compiled.

§30. The Standard Breakdown into Technological Complexes

In 1955 the Ministry of the River Fleet introduced at shipbuilding and ship-repair enterprises (by a ministry order) a breakdown of ships under repair into plan-reporting units and a standard breakdown into technological complexes, components and parts. This breakdown was made for the purpose of establishing the necessary technological sequence and the complete execution of repair work during the whole repair period, monitoring the observance of technological discipline, and making up complete sets of parts and components for assembly operations by the creation of consolidated plan-reporting units for the current planning and reporting of production.

A portion of the operations for repair (or for construction) of a ship that are technologically linked with each other, that are begun and ended within one technological unit, and that take no more than 20 calendar days for fulfillment in one department is called a complete technological complex.

For ship mechanisms, the breakdown is made by technological attribute in accordance with the production sequence of the assembly operations.

The standard breakdown for complete technological complexes that has been made for overhaul is the whole complex of work on the ship, broken down into the following categories, with a symbol for each of them as a code:

Breakdowns	Code
Overall ship operations	A
The metal hull	Zh
Wood in the hull and superstructure, room equipment, and furnishings	D
Structural and pictorial painting, and cementing, furnace, glass and insulating operations	O
The main diesel	N
The shaft line and propelling device	V
Ship apparatus and deck mechanism	U
Steam boilers	K
The main steam engine	M
The machinery compartment's auxiliary mechanisms	VM
Pipelines and systems	S
Radio equipment	R

The breakdowns include various large parts of the ship or types of repair work in such fashion that the main repair operations for each breakdown are carried out by one department or a homogeneous group of departments. Each breakdown is divided into one-digit numbers for components (not more than nine). For example, D-2 means: breakdown D, component 2. Each component, in turn, is divided into one-digit numbers for complete technological complexes (not more than nine). For example, D-23 signifies: breakdown D, component 2, complex 3.

For current repair, the structural breakdown as a whole is adopted for planning and reporting units (Zh, D, O and so on), for intermediate repair the consolidated structural component (Zh-1 is the metal hull, Zh-2 is the metal superstructure, and so on) is adopted, and for overhaul--a part of the structural component (Zh-11 is the stempost, transverse and longitudinal framing, preparation in a department, and repair or replacement on the ship) is adopted.

Unified repair lists for current and intermediate repair have been made up to take into consideration the standard breakdown for ships into complete technological complexes. The standard breakdown enables a unified system for planning, accounting and reporting to be used at the enterprises.

§35. Repair of Ships That Navigate Both Marine and Riverine Waters

The repair of ships that sail both marine and riverine waters is organized, planned and financed in accordance with the statute on repair, taking the specific conditions of their operation into account.

Ships that operate the year round are repaired in accordance with special schedules that include: lifting the ship onto a slipway for the USSR Registry classification examination--once in 4 years; planned placement on a slipway--once each 2 years; technical servicing after winter operation--annually; and technical servicing before winter operation--annually.

The annual PPR schedule for ships that operate the year round are made up by fleet owners no later than November of the year preceding the planned year, and they are approved by the shipping-line chief. They are made up as combined schedules with the schedules for technical servicing.

Repair and technical servicing are planned on the basis of the requirements of the rules of the RSFSR River Registry or the rules of the USSR Registry.

The placement on a slipway (or in a graving dock) of transport ships of the 11-SP, M-SP and M classes that are admitted to regions of navigation for M-SP ships is planned for every other year for those that operate in

marine regions more than 90 days per navigation season and once in 2 years for those that operate in these regions for 50-90 days per navigation season.

The current repair of ships that sail both marine and riverine waters is performed by ship-repair enterprises with the participation of ships' crews, special brigades, reserves of crew personnel, and BPU's. Current repair of 11-SP class ships is performed simultaneously with placement on the slipway.

At Ministry of the River Fleet enterprises, current and intermediate repair of ships that sail marine and riverine water is performed under unified repair lists and in accordance with the technological documentation, which is adjusted to wholesale prices. When they are repaired at enterprises of other jurisdictions (Ministry of the Maritime Fleet or Ministry of Fishing Industry), the repair documentation is made out on the basis of the terms of a preliminary arrangement with the executor of the repair, by representatives of the shipping lines' SSKh's.

The technical servicing of some elements of a ship are planned and performed while under way or at berthages, without loss of operating time by the ship's crew and by special BPU brigades.

Retention of the USSR Registry class should be provided for during the repair of 11-SP class ships, and, of ships engaged in foreign navigation, conformity with the requirements of the International Convention should be provided for. The repair of ships that have a USSR Registry class is performed only in accordance with the rules and requirements of that Registry.

A special commission, named by the shipping line chief, performs, together with representatives of the River Registry, the navigational inspectorate, and the services of ship traffic safety and navigational support, the acceptance for operation of ships that enter marine regions for hauling. The commission is required to thoroughly examine the ship and to check for the presence of the required ship documents, equipment and stock, the navigation-season supply, and the completeness of crew manning. In accordance with the results of the examination and the check, it makes up a certificate about the readiness of the ship and the crew to navigate in marine regions.

Chapter 8. Repair of the Main Marine Internal Combustion Engine.

§46. Types of Repairs

During operation, parts of the main marine DVS's [internal combustion engines] are subjected to various types of natural deterioration (abrasion, corrosion and metal fatigue). Working surfaces are abraded in kinematic pairs; surfaces that are washed by cooling water and hot gases are destroyed by corrosion; plastic deformation appears as a result of

degradation of the strength and plastic properties of the metal and of fatigue thereof under the influence of cyclic variable loads or temperature stresses. As a result of deterioration, parts lose their prescribed geometric shape, their original sizes are changed, and the established clearances for rubbing pairs exceed permissible tolerances, one surface becomes misaligned with another, the close fits of mated members are weakened, valve timing, fuel feed and lubrication become misaligned, and the engine's normal operation is disturbed. If the necessary measures are not taken, further operation can lead to engine breakdown.

The replacement at the required time even of small parts, the timely scouring of the cylinder sleeves, the grinding of valves, adjustment of the fuel equipment, and so on, provide for engine efficiency for a long time. The necessity for repair of DVS's and the amount of the repairs are determined as a function of the degree of part deterioration.

The natural deterioration of ship mechanisms under normal operating conditions is governed by definite laws under which approximate periods of service for parts can be established and a plan for conducting repair work can be set.

The speed of part wear is a function of many factors, and it is difficult to subject it to computation. Therefore, in practice the decision has been made to determine it in accordance with the thickness of the metal layer to which the dimension of a part has been reduced after 1,000 hours of operation, in accordance with the formula

$$v = \Delta R/T, \tag{28}$$

where ΔR is change in size of the part, in mm; and
T is the length of operating time of the part, in thousands of hours. For example, for a shaft $\Delta R_B = \frac{D_1 - D_2}{2}$ or for an orifice $\Delta R_0 = D_2 - D_1/2$, where D_1 and D_2 are, respectively, the diameters of the new and the worn part, in mm.

Knowing the speed of wear, the length of service life of parts and machines prior to maximum deterioration can be found, and engine life and planned repair dates, as well as the repair dimensions, can be established.

The average service life of a part (in thousands of hours) prior to maximum deterioration is determined by the formula:

$$T_{пр} = \Delta R_{пр}/v_{ср}, \tag{29}$$

where $\Delta R_{пр}$ is the maximum value of the change in size of a part as a result of deterioration, in mm; and
$v_{ср}$ is the average speed of wear, which is determined by methods of mathematical statistics, in mm/thousand hours.

Under the PPR system, ship machinery is subjected to current and intermediate repair and to overhaul during its service life.

Current repair of engines is conducted annually, as a rule, between navigation seasons. At the initiative of ship crews who had been sent to the Plant imeni Lenin, current repair on many self-propelled ships is being carried out not annually but once in 2 years. Intermediate repair of low-speed engines is made every 5-6 years and overhaul comes once in 20-25 years. High-speed engines are subjected to current repair annually; intermediate repair thereof is conducted each 3-4 years.

During current repair of the main marine low-speed internal combustion engine, the working surfaces of the cylinder liners, pistons and cylinder covers are inspected and cleaned off, the upper compression and oil-regulating piston rings are replaced, the crankshaft journals and bearings are cleaned and examined, the clearances are measured and adjusted, the valve-timing phases are checked and adjusted and the valves are ground, the injectors are pressure-tested and checked and, in some cases, replaced, the fuel pump is overhauled and worn parts replaced by new ones, and seal failures in pipeline joints is eliminated.

During current repair, a high-speed engine is partially disassembled and the piston rings are replaced. If its service life has run out (depending upon the design of the engine), the engine is replaced by another from an exchange pool, the one removed later undergoing factory repair at a specialized plant.

The list of operations for intermediate repair of a low-speed internal combustion engine includes: dismantling of the engine from the ship for shop repair (at a specialized plant), all parts are measured and inspected for defects, cylinder sleeves are bored out (to the repair dimensions) or are replaced, some cylinder covers are replaced and pistons are replaced or turned and the pins and rings replaced; the connecting-rod bolts are replaced, the crankshaft journals are cleaned, the connecting-rod and some frame bearings are rebabbited; the center lines of the shaft and cylinders are checked; all valves and injectors are overhauled and worn parts of the valve-timing mechanism are replaced by new ones; and the fuel pump is overhauled, with worn parts replaced by new ones.

During intermediate repair, a high-speed engine is dismantled and replaced by an engine from an exchange pool. The dismantled engine is repaired at a specialized plant (or in a experiment) with full disassembly. In so doing, the crankshaft is turned or replaced; cylinder liners, pistons, piston pins, connecting-rod bolts and fuel equipent are replaced; the fit zones of the cylinder blocks are turned; the crankshaft journals are turned and polished, and the fit of the main and connecting-rod bearings is calibrated to the repair dimensions.

§50. The Restoration of Worn Parts

When ship mechanisms are repaired, not only are parts replaced by new ones, but worn ones also are restored. Parts are restored by various methods: welding and building up, electric metallization by dispersion, electrolytic steeling, and gluing. Chromizing also is used.

Welding and Deposition. Electric-arc, electroslag and gas welding are used widely in ship repair. Deposition is done by manual, automatic and semiautomatic methods, and under a flux layer, electroslag welding is done automatically, and gas welding is done by manual and automatic methods. The nominal sizes of parts of mechanisms and parts of steam boilers and ship hulls that have mechanical deterioration and corrosion are restored by deposition. Parts that are cracked or pitted are restored by welding.

Electrometallization. This is used for restoring the journals of screw and connecting shafts, the working surfaces of bearings, and the outer surfaces of cylinder sleeves of DVS's, and for correcting casting and machining defects, as well as for forming anticorrosion coatings.

The essence of electrometallization consists in the application of melted metal by a stream of air onto a part's surface. Special apparatus--electrometallizers into which a wire is fed, to be melted by its electrical arc--is used for this purpose. The molten metal is sprayed by compressed air and is applied to the part's surface. This provides for a sufficiently strong coalescence of the part's metal with the coating. This method enables a high-quality coating made of various metals to be created on the surfaces of parts of ships' mechanisms that are made of steel, cast iron, bronze, aluminum and other metals.

Steeling. Worn working surfaces of important cast-iron and steel parts--pistons, sleeves, cylinders, rods, valves, pins, shaft journals, and other items are restored by this method. Steeling is the process of electrolytic deposition of iron on the surface of the part being restored during the passage of a DC current of 6 volts through a solution of salts of ferrous chloride ($FeCl_2 4H_2O$) or of ferrous sulphate ($FeSO_4 7H_2O$).

For steeling, an anode--a rod with a ring made of low-carbon steel--and the part, which simultaneously is the cathode, are hung on special hangers and placed into a bath that is filled with an electrolyte. Under the action of the current from the electrolyte (the salt solution), ions are separated and deposited on the surface of the part, covering it with a layer of iron. The anode is dissolved, and its ions enter into the electrolyte, replacing the ions that are deposited on the cathode. In order to execute the steeling, the bath is heated by an electrical coil, and the temperature of electrolyte heating is monitored by a thermometer. The iron layer deposited is 2-3 mm or more in thickness. Steel welded baths coated with acid-resistant enamel or faced with chemically resistant heat-conducting tiles are used for steeling.

Gluing. This is finding increasingly wide use in repairing worn parts. Natural and synthetic resins, liquid glass, rubber and others are used as the gluing substance (adhesive). The restoration of worn parts by gluing is marked by simplicity of the operating process, high productivity and low cost of the work.

Epoxide type BF, carbinol and other glues are used for ship repair.

Epoxide glues possess high adhesion to the surfaces of materials and metals, mechanical strength and anticorrosion resistance. Industry produces glues based on the resins ED-6 and ED-5 for cold and hot hardening. These glues have obtained the widest propagation in ship repair.

The composition of a glue for cold hardening (18-25 degrees C) includes (by weight): epoxide resin ED-6 or ED-5 (100 parts), plasticizer--dibutyl phthalate (20 parts), hardener--polyethylene polyamide (7-9 parts) and filler (iron oxide, titanium dioxide, asbestos meal) for reducing shrinkage.

Eposide glue for hot hardening (150-200 degrees C) consists (by weight) of epoxide resin ED-6 (100 parts), a hardener--maleic anhydride (35 parts), a plasticizer--dibutyl phthalate (5 parts) and a filler--porcelain meal (150 parts).

Glues based on epoxide resins are called epoxide compounds. They are use to glue various parts or broken parts made of ferrous or nonferrous metals, and also of plastic, for restoring the fit zones of the cylinder sleeves of internal combustion engines and of cylinder blocks, for protecting the surfaces of blocks and cylinder liners from corrosion, for eliminating flaws in castings, and for other purposes.

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